Combinatorial Design Theory
Théorie combinatoire du design
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A new type of orthogonality for t-designs

Let t, k, v be integers with $0 \leq t \leq k \leq v$. A Steiner system, $\mathsf{S}(t,k,v)$ is a pair $(X, \mathcal{A})$ where X is a v-element set and $\mathcal{A}$ is a set of k-subsets of X, called blocks, with the property that every t-element subset of X is contained in precisely one block of $\mathcal{A}$. If the blocks $\mathcal{A}$ of a Steiner system $\mathsf{S}(t,k,v)$ defined on X can be partitioned into $\mathsf{S}(i,k,v)$, then the Steiner system is called i-resolvable. In this talk, I will introduce β-orthogonality for i-resolvable Steiner systems and the associated arrays called (t,i,β)-Kirkman squares. Orthogonal packings in projective space can be used to construct the first infinite class of $(3,2,\beta)$-Kirkman squares. These designs can be used to construct optimal doubly constant weight codes with perfect $(1,2)$ covers, thus answering a long open question on the existence of such codes. This work is closely connected to several interesting open problems in design theory and finite geometry.

SHUXING LI, University of Delaware

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Weak 3-Coloring of Resolvable 4-Cycle System

A weak k-coloring of a resolvable m-cycle system $\mathcal{S}$ of order v (that is, a C_m-factorization of K_v) is an assignment of k colors to its vertices such that no m-cycle in any 2-factor is monochromatic; that is, every m-cycle receives at least two distinct colors. The weak chromatic number of $\mathcal{S}$ is the minimum number of colors k for which $\mathcal{S}$ admits a weak k-coloring.

While there has been substantial research on colorings of m-cycle systems (that is, C_m-decompositions of K_v), relatively little attention has been given to weak colorings of resolvable m-cycle systems. In this talk, we consider weak 3-colorings of resolvable 4-cycle systems.

This is joint work with Dr. Peter Danziger and Dr. Andrea Burgess.

MATEJA ŠAJNA, University of Ottawa
A recursive approach to the Oberwolfach problem and its variants

The celebrated Oberwolfach problem (OP), first posed by Ringel in 1967, asks whether n participants at a conference can be seated at k round tables of sizes $m_1, \ldots, m_k$ (where $m_1 + \ldots + m_k = n$) for several meals so that everybody sits next to everybody else exactly once. OP can be modeled as a decomposition of the complete graph K_n into 2-factors, each consisting of k disjoint cycles of lengths $m_1, \ldots, m_k$.

For cycles of uniform length, OP was solved decades ago, and it has recently been shown that it has a solution for all sufficiently large n. In addition, many infinite families of cases with variable cycle lengths (e.g. the two-table case and the bipartite case) are known to have a solution, however, in general, OP is still open and highly relevant. Moreover, many variants, each modeling a different seating arrangement, have been investigated recently.

In this talk, I will describe a recursive approach that allows us to use a solution to a smaller case of OP or variant to construct a solution to a larger case (typically adding one sufficiently long cycle). This approach has already been used successfully to obtain new solutions to several infinite families of cases of the directed OP (for complete symmetric digraphs), and I will outline my plans for some of the other variants. This talk will also serve as an introduction to the talks by Marie Rose Jerade and Josephine Brooks.

KIANOOSH SHOKRI, University of Ottawa

BRETT STEVENS, Carleton University
Embedding a graph in a Steiner Triple System?

Since every pair of vertices appear in a block of a Steiner Triple System, what would it even mean to embed a graph in a STS; after all every graph is a subgraph of a complete graph. I will discuss more meaningful ways to interpret the idea of embedding a graph and discuss when embeddings exists, bounds on their sizes and small embeddings. One interpretation connects to the combinatorial game Node Kayles and its hypergraph generalization NoFil.

DOUGLAS STINSON, University of Waterloo / Carleton University